

## PATENT SPECIFICATION

963,392



DRAWINGS ATTACHED

963,392

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and RICHARD CLEMINSON CUSSONS*Date of filing Complete Specification:* Jan. 10, 1961.*Application Date:* Jan. 26, 1960.

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## COMPLETE SPECIFICATION

## Fusible Plug Assembly

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fusible plug assemblies for pneumatic tyres and wheels therefor and more particularly relates to such assemblies for aircraft wheels and tubeless tyres.

Very considerable amounts of heat are generated in the wheel brakes when an aircraft lands and this heat, gradually soaking through to the wheel rim, can, unknown to the pilot, damage the wheel tyre to such an extent that failure may occur. This failure may take place a considerable time after the braking operation, and the subsequent explosion is a hazard to passengers and personnel when the aircraft is on the ground and, if the aircraft should have taken off again, the explosion may seriously damage the aircraft wing or the part of the aircraft where the wheel is normally stowed when retracted.

The object of the present invention is to prevent such an explosion from occurring.

According to the present invention a fusible plug assembly comprises a bush adapted to be fitted to the rim of a wheel for a pneumatic tubeless tyre, a plunger air-tightly fitted in a passage through said bush, and plunger-retaining means comprising a plug of fusible metal which melts when it reaches a predetermined temperature to allow the plunger to be ejected from the bush by the inflation pressure of the tyre, the arrangement being such that on ejection the plunger carries with it the portion of the plug blocking said passage.

The plunger tends to be forced outwardly of the bush by the pressure in the tyre and is restrained from such movement by the fusible plug, which may abut one end of the plunger or be located in a groove in the plunger adjacent its other end or be fitted trans-

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versely through holes in the plunger and bush. In this latter case the fusible plug can be in the form of a rod. The plunger is fitted air-tightly in said passage in the bush usually by suitable means such as a disc of rubber or rubber-like material abutting the end of the plunger remote from the fusible plug.

According to the present invention also an aircraft tubeless tyre and wheel assembly comprises a fusible plug assembly of the kind hereinabove defined.

Two embodiments of the present invention are described, by way of example, in the following description with reference to the accompanying drawings, in which:

Figure I is a partial cross-section of a wheel carrying a pneumatic tubeless tyre and fitted with a fusible plug assembly,

Figure II is a cross-sectional elevation of the fusible plug assembly shown in Figure I,

Figure III is a plan view of the fusible plug assembly,

Figure IV is a partial cross-section of a further wheel and pneumatic tyre assembly fitted with a fusible plug assembly,

Figure V is a cross-sectional elevation of the plug shown in Figure IV, and

Figure VI is a plan view of the plug.

Referring to Figures I, II and III a fusible plug assembly 1 is shown fitted to the rim base 2 of a wheel intermediate the tyre bead-carrying portions 3. The fusible plug assembly 1 comprises a cylindrical externally screw-threaded bush 4 having a hexagonal head 5 at one end. The bush 4 is drilled through a longitudinal axis to form two cylindrical communicating chambers 6 and 7, one of larger diameter than the other, each of substantially equal length, the larger diameter chamber 7 being at the headed end 5 of the bush 4, and being screw-threaded. The outwardly-facing end of the chamber 6 is countersunk to a short depth.

An externally screw-threaded cylindrical plug 8 of fusible material is screwed into the

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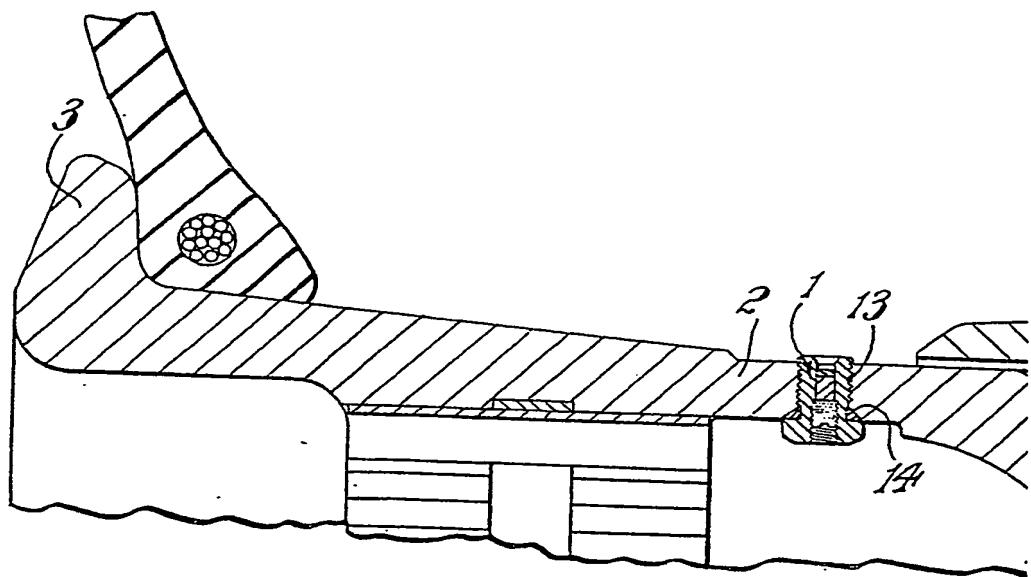
- larger diameter chamber 7 until it abuts the end thereof. The plug is made of a metal arranged to fuse or melt rapidly at a predetermined critical temperature which, in this particular case, is a temperature slightly higher than that which might cause damage to a tyre. The plug 8 is shorter in length than the chamber 7 and is provided with a slot 9 in its outwardly-facing end 10 to facilitate fitting of the plug in the chamber 7 or removal therefrom.
- Slidably-fitted in the smaller diameter chamber 6 is a cylindrical plunger 11, one end of which abuts the adjacent end of the fusible plug and abutting the other end of the plunger 11 is a disc-like seal 12 of rubber or rubber-like material.
- The bush 4 which may be small, e.g. of the order of 0.25 inch diameter, is screwed in a countersunk hole 13 drilled in the rim base 2 of an aircraft wheel for a tubeless tyre with the hexagonal head 5 outwardly of the tyre. A resilient rubber O-ring 14 is fitted between the underside of the rim base 2 and the head 5 of the bush to prevent leakage of air from within the tyre.
- The axial length of the bush 4 may conveniently be equal to the thickness of the rim base 2 and the bush is made of a metal having a high thermal conductivity coefficient so that, as the rim heats up during a braking operation, so the bush heats up at substantially the same rate. The fusible plug 8 is in intimate contact with the bush since the screw-threaded engagement therewith materially increases the conducting area, so that, when the critical temperature of the plug is reached it will, quite suddenly, melt, and the plunger 11 and sealing disc 12, forced against it by the internal pressure of the tyre, will cause it to disintegrate and be forced, in liquid form, clear of the bush 4. The plunger 11 and sealing disc 12 will follow it, thus leaving the passage through the bush clear and so allowing the tyre to deflate.
- The construction described has the advantage that the plunger 11, in its ejection from the bush 4, drives a clear passage through the molten or semi-molten fusible plug and thus prevents droplets of the semi-molten metal from solidifying within the bush and obstructing the clear passage therethrough.
- The metal comprising the fusible plug is one of a type adapted to melt when a predetermined temperature is reached. For example, the fusible plug can be formed from an eutectic alloy or from any other alloy having the desired melting point, or from a single metallic element. Until that temperature is reached it is mechanically strong enough to withstand the pressure exerted upon it by the plunger.
- The temperature at which the plug should be capable of fusing should be chosen with some care, since it must fuse just before the
- tyre is likely to fail due to overheating and thereby prevent an explosion. On the other hand, it must not fuse too early, since the tyre would vent prematurely and damage may be caused by, e.g. landing on a deflated tyre. Preferably, the plug is adapted to fuse at a temperature slightly higher than that at which structural damage to the tyre occurs, since there is a temperature gradient between the plug, which is situated close to the brake, and the tyre beads, which are spaced a little way away from the brake.
- It has been found that a plunger seal of disc shape gives the best results, since with such a seal there is less likelihood of it deforming under the tyre pressure and binding in its passage.
- A second form of fusible plug assembly is shown in Figures IV, V and VI. The fusible plug assembly 20 comprises a cylindrical externally screw-threaded bush 21 having a hexagonal head 22 at one end. The bush is drilled longitudinally to form two chambers 23 and 24 of different diameter, as in Figure II, but with the larger diameter chamber 24 remote from the headed end 22. An internally screw-threaded cylindrical plug 25 is screwed into the larger diameter screw-threaded chamber 24 and abuts the end thereof. A plunger 26 is slidably-fitted in the smaller diameter chamber 23 to abut the end of the fusible plug, and abutting the other end of the plunger is a disc-like seal 27 of rubber or rubber-like material.
- The fusible plug assembly is shown in Figure IV fitted to the rim base 28 of a vehicle wheel carrying a pneumatic tubeless tyre, but in this case the headed end lies within the tyre chamber.
- The operation of the plug is similar to that described in the previous embodiment, but in this case, if it is desired to change the plug, then it is necessary to remove the tyre from the wheel rim to do so.
- In another embodiment of the present invention the larger diameter chamber through the bush is not screw-threaded nor is the fusible plug, and the plug is slidably-fitted in said chamber and is retained therein by a member force-fitted therein.
- In a further embodiment of the invention the plunger is provided with an annular sealing ring and a shear plug of fusible metal is fitted through a hole transversely of the plunger and the bush.
- In yet a further embodiment of the invention the plunger is provided, adjacent its end communicating with the tyre, with a reduced diameter neck on which is fitted a C-shaped washer of fusible metal which is supported on a step formed in the passage through the bush.
- All these embodiments are characterised in that, when the fusible plug or washer reaches a predetermined and critical temperature it will melt and allow the plunger to be ejected

- from the passage, the arrangement being such that, as the plunger is ejected it carries with it the major part of the plug or washer, thus ensuring that the passage through the bush is clear to allow the air pressure of the tyre to escape.
- WHAT WE CLAIM IS:—**
1. A fusible plug assembly comprising a bush adapted to be fitted to the rim of a wheel for a pneumatic tubeless tyre, a plunger air-tightly fitted in a passage through said bush, and plunger-retaining means comprising a plug of fusible metal which melts when it reaches a predetermined temperature to allow the plunger to be ejected from the bush by the inflation pressure of the tyre, the arrangement being such that on ejection the plunger carries with it the portion of the plug blocking said passage.
  2. A fusible plug assembly according to claim 1 wherein said plug of fusible material is fitted tightly within said passage and abuts one end of said plunger.
  3. A fusible plug assembly according to claim 1 or 2 wherein said passage comprises two intercommunicating cylindrical chambers, one of larger diameter than the other, said plunger being fitted in the smaller diameter chamber and said plug being fitted within said larger diameter chamber abutting the end thereof and one end of the plunger.
  4. A fusible plug assembly according to claim 3 wherein the other end of said plunger abuts air-sealing means for said plunger.
  5. A fusible plug assembly according to claim 4 wherein said sealing means comprises a disc of rubber or rubber-like material fitted air-tightly within said smaller diameter chamber.
  6. A fusible plug assembly comprising an externally screw-threaded cylindrical bush having a head at one end, a longitudinal passage through said bush comprising two intercommunicating cylindrical chambers, one of larger diameter than the other, a plunger fitted within the smaller diameter chamber, a plug of fusible metal fitted tightly within the larger diameter chamber abutting the end thereof and one end of said plunger, the other end of said plunger abutting a disc of rubber or rubber-like material fitted air-tightly within said smaller diameter chamber.
  7. A fusible plug assembly according to claim 6 in which said larger diameter chamber is at the end of said bush remote from the headed end.
  8. A fusible plug assembly according to claim 6 wherein said larger diameter chamber is at the end of said bush adjacent said headed end.
  9. A fusible plug assembly according to any one of claims 6 to 8 wherein said larger diameter chamber is screw-threaded and said plug of fusible metal is cylindrical in shape and screw-threaded externally and adapted to be screwed tightly into said larger diameter chamber.
  10. A fusible plug assembly according to claim 1 wherein said plunger-retaining means comprises a rod of fusible metal fitted transversely through holes in the plunger and bush.
  11. A fusible plug assembly according to claim 10 in which the plunger is provided with an annular sealing ring.
  12. A method according to any one of claims 1 to 8 wherein the fusible plug is slidably-fitted within said larger diameter chamber and is retained therein by a member force-fitted therein.
  13. A fusible plug assembly according to claim 1 wherein the plunger is provided adjacent its end presented towards the interior of the tyre with a reduced diameter neck on which is fitted a C-shaped washer of fusible metal which is supported on a step formed in said passage through the bush.
  14. An aircraft tubeless tyre and wheel assembly having fitted in a hole in the rim base a fusible plug according to any one of the preceding claims.
  15. A fusible plug assembly constructed and arranged substantially as described herein and shown in Figures II, III, V and VI of the accompanying drawings.
  16. A pneumatic tubeless tyre and wheel assembly constructed and arranged substantially as described herein and shown in Figures I and IV of the accompanying drawings.

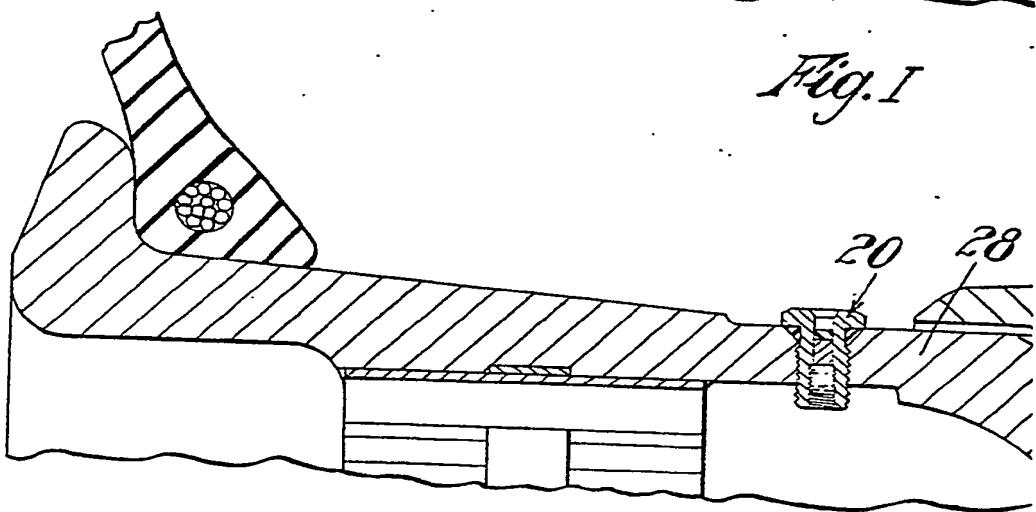
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Agent for the Applicants.

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*Fig. I*



*Fig. IV*

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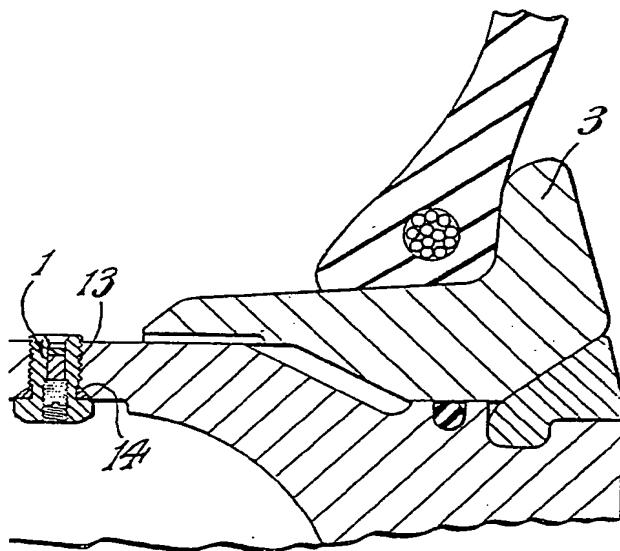


Fig. I

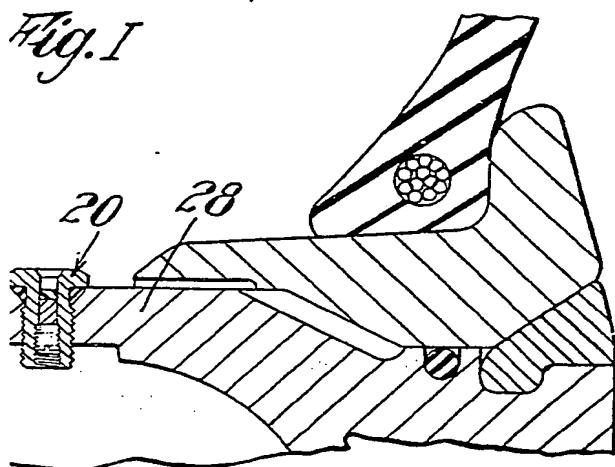


Fig. IV

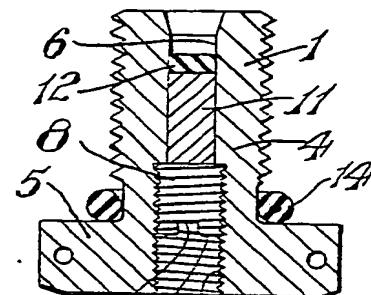


Fig. II

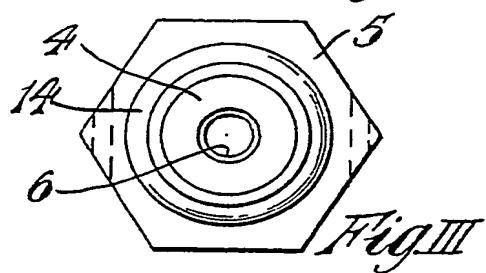


Fig. III

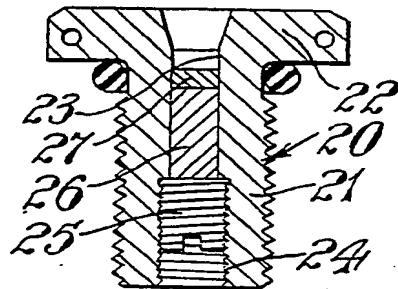


Fig. V

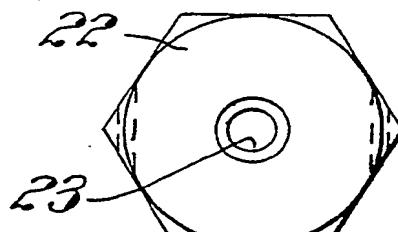


Fig. VI

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